REMARKS

Upon entry of Applicants' Amendment of September 28, 2009, Claims 1, 4, 6 through 9, 11, 14 and 15 are pending in the application.

Claim 1 has been amended to reflect advantageou cellulose ethers selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropylcellulose or ethylhydroxyethylcellulose. Support for this amendment can be found in the Application-as-filed, for example in Claim 6 as-filed.

Claim 6 has been canceled, as its subject matter has been incorporated into Claim 1.

Reexamination and reconsideration of this application, withdrawal of all rejections, and formal notification of the allowability of the pending claims are earnestly solicited in light of the remarks which follow.

Section 112 Rejections

Claim 1 stood rejected over the recitation of a solvation delay of "a minimum of a few seconds." The Examiner has kindly indicated within the Advisory Action mailed October 20, 2009, that the foregoing rejection has been withdrawn, based upon Applicants' Amendment of September 29, 2009.

Claim 1 stood further rejected over the recitation "sole viscosity developer." The Examiner has likewise kindly indicated within the Advisory Action mailed October 20, 2009, that the foregoing rejection has been withdrawn, based upon Applicants' Amendment of September 29, 2009.

The Claimed Invention is Patentable in Light of the Art of Record

Claims 1, 4, 6 through 9, 11, 12, 14 and 15 stand rejected over United States Patent No. 3,072,635 to Menkart et al in light of United States Patent No. 4,366,070 to Block..

It may be useful to briefly consider the invention before addressing the merits of the rejection.

Cellulose ethers are known as viscosity builders and the like for a wide variety of applications. The production of aqueous solutions containing such cellulose ethers can be problematic; however. If such a cellulose ether powder comes into contact with water, the individual granules swell and clump together to form relatively large agglomerates.

Cellulose ethers crosslinked with glyoxal are known to have reduced swelling, as clearly evidenced by Menkart. Carbaldehyde groups on the glyoxal react with hydroxy groups on the cellulose ether to form hemiacetal bonds. Hemiacetal bonds are pH sensitive, and cleave when the cross-linked cellulose ether is stirred into neutral or weakly acidic water, as discussed in the Application-as-filed on Page 2, lines 26 through 30, and as further correctly noted by the Examiner. Such cleavage is problematic because it reintroduces the glyoxal back into solution. Glyoxal, as well as a number of other low-molecular weight cross-linkers, pose a potential health risk. Glyoxal has in recent years been categorized as a mutagen and sensitizing substance, for example.

Alternative crosslinkers to glyoxal are generally known. Unfortunately, Applicants have determined that cellulose ethers formed using alternative crosslinkers form lumps upon introduction into an aqueous solution, as indicated in Comparative Example 2 within the accompanying declaration. Although arguably acceptable for more rugged applications, such cellulose ether lumps are highly problematic for sensitive applications.

Altogether unexpectedly, Applicants have found that the process by which the crosslinked cellulose ether is formed determined its tendency to lump upon subsequent dissolution within application-solutions. Applicants have more particularly found that processes to produce crosslinked cellulose ether that initially merely moisten but do not dissolve the cellulose ether produce crosslinked cellulose ethers that can subsequently be introduced into aqueous application-solutions without lump formation.

A comparison of the lump-free solutions provided by the inventive methods in comparison to the lumps formed during dissolution of cellulose ethers containing identical cross-linker formed via a dilute solution is provided in the Declaration by Dr. Andreas Schultz, attached as Exhibit I.

Applicants have thus more particularly found that methods of forming crosslinked cellulose ether that initially merely moisten but do not dissolve the cellulose ether as it is combined with a chemical compound containing at least one aldehyde group and at least one acid group in the range from 0.01 to 0.1 mol per mole of cellulose ether exhibit lump-free stirrability upon subsequent introduction of the crosslinked cellulose ether into aqueous solutions. In addition, the inventive reversibly crosslinked ethers do not release low molecular weight compounds upon dissolution in aqueous solutions.

Applicants respectfully submit that the inventive balance of lump-free stirrability and lack of small molecule release upon dissolution is highly advantageous and heretofore unknown.

In expedient embodiments, the cellulose ethers having free OH groups are selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropylcellulose or ethylhydroxyethylcellulose. Each of the foregoing cellulose ethers has a reduced number of free hydroxy groups (because these groups have been converted into methyl ether or ethyl ether groups) and only the least reactive hydroxy groups remain to participate in the crosslinking reaction. Consequently, it was quite surprising that such cellulose ethers with a reduced number

of hydroxy groups and reduced reactivity could be reversibly crosslinked with compounds having at least one acid group and at least one aldehyde group.

Accordingly, the claims are directed to methods for producing reversibly crosslinked cellulose ethers comprising first admixing, but not dissolving, cellulose ethers having free OH groups in water or an organic suspension medium with chemical compounds containing at least one aldehyde group and at least one acid group in an amount ranging from 0.01 to 0.1 mol per mole of cellulose ether, in which the resulting reversibly crosslinked cellulose ether provides lump-free stirrability. The chemical compounds containing at least one aldehyde group and at least one acid group are not released upon dissolving said reversibly crosslinked cellulose ether in a neutral or weakly acidic aqueous solution, as recited in the claimed invention.

In expedient embodiments, the cellulose ethers having free OH groups are selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropyl-cellulose or ethylhydroxyethylcellulose, as recited in Claim 1 as-amended.

In advantageous embodiments, the cellulose ether is pre-moistened with either 40 to 80 % water or 30 to 60% organic suspension medium, as recited in Claim 11.

In particularly beneficial aqueous aspects of such embodiments, the cellulose ether is pre-moistened with 40 to 80% water, the pre-moistened cellulose is admixed with water and chemical compounds containing at least one aldehyde group and at least one acid group, the admixed cellulose ether composition is comminuted; the comminuted cellulose ether composition is milled and the milled cellulose ether composition is then crosslinked to form an ester or hemiacetal bond, as recited in Claim 14. The recited pre-moistening with the recited elevated quantities of water in combination with comminuting and milling of the composition prior to crosslinking provides for extremely uniform crosslinking within the resulting crosslinked cellulose.

Particularly advantageous organic-suspension aspects of such embodiments comprise (i) pre-suspending cellulose ether having free OH groups in 30 to 60% organic suspension medium; (ii) admixing the pre-suspended cellulose ether with an organic suspension medium and chemical compounds containing at least one aldehyde group and at least one acid group; (iii) filtering the admixed cellulose ether composition; (iv) drying the filtered cellulose ether composition; (v) comminuting the filtered cellulose ether composition; and (vi) heating the comminuted cellulose ether composition to react the acid groups and aldehyde groups of the chemical compounds with the OH groups of the cellulose ethers to form an ester bond or hemiacetal bond at a temperature ranging from 50 to 105 °C, as recited in Claim 15. The recited pre-moistening with the recited elevated quantities of organic suspension medium in combination with comminuting of the composition prior to crosslinking likewise provides for extremely uniform crosslinking within the resulting crosslinked cellulose.

Applicants respectfully reiterate that the cited references do not teach or suggest the claimed invention, considered either alone or in combination.

Menkart is merely directed to the conventional use of aldehyde treating agents with cellulose ether, particularly sodium carboxymethyl cellulose. (Col. 1, lines 45 – 58; Col. 4, lines 1 – 5; Col. 4, line 24; Col. 4, line 44; Col. 4, line 59 and Col. 5, lines 55 - 60). Menkart generally indicates that any of glyoxal, formaldehyde or succinaldehyde may be reacted with cellulose ethers, with glyoxal being preferred. (Col. 1, lines 48 – 50). Menkart generically teaches that moisture is important for "good contact" with the treating agent. (Col. 3, lines 4 – 6).

In contrast to the inventive methods, Menkart teaches that processes forming either dilute solutions or those merely dampening the cellulose ether are equivalent to form crosslinked cellulose ethers. Menkart particularly expressly teaches the use of dilute cellulose ether solutions, such as a 10 % cellulose ether solution in alcohol. (Col. 5, lines 55 – Col. 6, line 4). Menkart alternatively teaches the spraying of glyoxal onto "moist" cellulose particles containing up to 90 % cellulose ether (i.e. as little as 10% moisture). (Col. 3, lines 8 – 11 and lines 50 – 55) Menkart's working example directed to spray application incorporates cellulose ether containing

about 80 % cellulose ether (i.e. about 20% moisture). (Col. 6, line 70 – Col. 7, line 3). In fact, Menkart even discloses the treatment of presumably dry cellulose ether on a wire screen with glyoxal vapor. (Col. 3, lines 67 – 70).

Menkart expressly teaches that "when employing a solvent for the aldehyde treating agent," the cellulose ether can first be "suspended in" the solvent containing the aldehyde treating agent for up to 30 minutes after which the liquid is separated off and the cellulose ether containing the absorbed aldehyde solution is dried. (Col. 3, lines 34 – 40). Applicants respectfully reiterate that Menkart is altogether silent as to any definition for "suspended in." Applicants further respectfully make of record that Menkart's cited Example 5 incorporates carboxymethylcellulose ("CMC") containing 21.5 % water (i.e. moisture) into its crosslinking solution, with the noted CMC having been blended from cellulose "wet product" containing the cited 38 % water. (Col. 6, lines 70 – Col. 7, line 3).

Applicants respectfully reiterate that Menkart, altogether silent as to agents other than its aldehyde treating agents, does not teach or suggest the inventive methods for producing reversibly-crosslinked cellulose ethers in which cellulose ethers having free OH groups are admixed with chemical compounds containing at least one acid group. Applicants respectfully reiterate that there would have been no motivation for Menkart to have incorporated the recited chemical compounds containing at least one acid group, as there would have been no expectation of success.

Menkart, expressly indicating both extraordinarily concentrated and dilute solutions of cellulose ether as equivalent for combination with its aldehyde treating agents, further does not teach or suggest that methods for producing reversibly crosslinked cellulose ethers comprising first admixing, but not dissolving, cellulose ethers in water or an organic suspension medium along with chemical compounds containing at least one aldehyde group and at least one acid group would result in reversibly crosslinked cellulose ethers providing lump-free stirrability, as recited in the claimed invention.

As evidenced by the facts presented in the testing performed by Dr. Schultz described within the attached Declaration, the lump-free stirrability provided by the solutions of the claimed methods is altogether unexpected. Particularly, the lump-free stirrability provided by first admixing but not dissolving the cellulose ether in comparison to methods in which cellulose ether is initially dissolved quite surprisingly results in lump-free stirrability within subsequent crosslinked cellulose ether solutions when incorporating chemical compounds containing at least one aldehyde group and at least one acid group as the crosslinker. Menkart does not even recognize initial cellulose ether concentration as result effective variable, much less a result effective variable in imparting lump-free stirrability.

Nor does Menkart teach or suggest that chemical compounds containing at least one aldehyde group and at least one acid group are not released upon dissolving said reversibly crosslinked cellulose ether in a neutral or weakly acidic aqueous solution, as further recited in Claim 1.

And Menkart, primarily directed to carboxymethyl cellulose, most certainly does not teach or suggest methods for producing reversibly crosslinked cellulose ethers by admixing cellulose ethers selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropylcellulose or ethylhydroxyethylcellulose with chemical compounds containing at least one acid group and at least one aldehyde group, as recited in Claim 1 as-amended. As noted above, each of the foregoing recited cellulose ethers has a reduced number of free hydroxy groups (because these groups have been converted into methyl ether or ethyl ether groups) and only the least reactive hydroxy groups remain to participate in the crosslinking reaction. It was thus altogether unexpected that such cellulose ethers with a reduced number of hydroxy groups and thus reduced reactivity could be reversibly crosslinked with compounds having at least one acid group and at least one aldehyde group, as the recited crosslinkers are significantly less reactive than conventional aldehyde crosslinkers.

Menkart likewise fails to teach or suggest that processes in which cellulose ether is pre-moistened with either 40 to 80 % water or 30 to 60% organic suspension medium would result in lump-free stirrability, as recited in Claim 11. As noted above, Menkart merely blends "wet" and dry batches of cellulose ether to provide cellulose ether containing 21.5 % moisture.

Nor does Menkart teach or suggest particularly beneficial embodiments, in which the cellulose ether is pre-moistened with 40 to 80% water, the pre-moistened cellulose is admixed with water and chemical compounds containing at least one aldehyde group and at least one acid group, the admixed cellulose ether composition is comminuted; the comminuted cellulose ether composition is milled and the milled cellulose ether composition is then crosslinked to form an ester or hemiacetal bond, as recited in Claim 14. In contrast the urgings of the Office Action on Page 11, last partial paragraph, Menkart's teachings of mere "mixing" or "tumbling" do not provide guidance for the recited "comminuting" and "milling." Applicants respectfully reiterate that the recited comminuting and milling provide significant, and altogether unexpected benefits over merely mixing, and such processes are not suitable for use with dilute solutions, such as the solutions taught by Menkart.

Menkart likewise fails to teach or suggest expedient embodiments that include (i) pre-suspending cellulose ether having free OH groups in 30 to 60% organic suspension medium; (ii) admixing the pre-suspended cellulose ether with an organic suspension medium and chemical compounds containing at least one aldehyde group and at least one acid group; (iii) filtering the admixed cellulose ether composition; (iv) drying the filtered cellulose ether composition; (v) comminuting the filtered cellulose ether composition; and (vi) heating the comminuted cellulose ether composition to react the acid groups and aldehyde groups of the chemical compounds with the OH groups of the cellulose ethers to form an ester bond or hemiacetal bond at a temperature ranging from 50 to 105 °C, as recited in Claim 15.

Accordingly, Applicants respectfully submit that the presently claimed method is patentable in light of Menkart, considered either alone or in combination with the remaining art of record.

Applicants respectfully submit that the claimed invention is likewise patentable in light of Block.

Applicants respectfully reiterate that Block is generally directed to improved well drilling fluids. (Col. 1, lines 17 – 20). The drilling fluids of Block include both a crosslinked cellulose and an aluminum compound to impart the desired rheology. (Col. 3, line 42 – 56 and Col. 6, lines 10 – 16). In fact, Block cautions that crosslinked cellulose alone does not impart adequate rheological properties, and thus must be used in combination with an aluminum agent. (Col. 6, lines 31 – 35 and Col. 10, lines 18 - 20). Block goes on to particularly illustrate and discuss within his working examples that the crosslinked cellulose alone does not impart suitable rheology. (Col. 10, lines 9 – 20).

Block indicates that any of a generic laundry list of cellulosic crosslinking agents is suitable for its cellulose. (Col. 5, lines 24 – 55). Block's working examples incorporate glyoxal, paraformaldehyde or epichlorohydrin along with the cellulose. (Col. 9, lines 14 – 39). Block merely generically notes that the crosslinked cellulose may be formed by reacting the cellulose ether in an aqueous medium, followed by "conventional" recovery techniques associated with the recovery of dissolved components from solutions, such as precipitation, filtration and drying. (Col. 5, line 63 – Col. 6, line 2). The working examples indicate that the "aqueous medium" is a 5 % solution of HEC. (Col. 5, lines 63 – 65 and Col. 9, lines 14 – 35). Block indicates that his compositions are ultimately intended for use at an alkaline pH, such as a pH ranging from 8 to 12. (Col. 8, lines 57 – 60). The working examples indicate that the crosslinked cellulose is adjusted to a pH of 9.5. (Col. 9, lines 21 – 27).

Applicants respectfully reiterate that Block does not teach or suggest the claimed methods, in which the cellulose is first admixed but not dissolved within the water or suspension medium. Block instead treats the HEC in very dilute form and thus the reaction is carried out in a homogeneous system, i.e. the HEC is dissolved in the water.

Block thus can not teach or suggest that methods for producing reversibly crosslinked cellulose ethers comprising first admixing, but not dissolving, cellulose ethers in water or an organic suspension medium along with chemical compounds containing at least one aldehyde group and at least one acid group would result in reversibly crosslinked cellulose ethers providing lump-free stirrability, as recited in the claimed invention.

Nor does Block teach or suggest that chemical compounds containing at least one aldehyde group and at least one acid group are not released upon dissolving said reversibly crosslinked cellulose ether in a neutral or weakly acidic aqueous solution, as further recited in Claim 1. Block instead expressly teaches that compositions incorporating his crosslinked cellulose are alkaline.

And Block most certainly does not teach or suggest such methods for producing lump-free reversibly-crosslinked cellulose ethers by admixing cellulose ethers selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropylcellulose or ethylhydroxyethylcellulose with chemical compounds containing at least one acid group and at least one aldehyde group, as recited in Claim 1 as-amended

Block likewise does not teach or suggest that processes in which cellulose ether is pre-moistened with either 40 to 80 % water or 30 to 60% organic suspension medium would result in lump-free stirrability, as recited in Claim 11.

Block further does not teach or suggest particularly beneficial embodiments, in which the cellulose ether is pre-moistened with 40 to 80% water, the pre-moistened cellulose is admixed with water and chemical compounds containing at least one aldehyde group and at least one acid group, the admixed cellulose ether composition is comminuted; the comminuted cellulose ether composition is milled and the milled cellulose ether composition is then crosslinked to form an ester or hemiacetal bond, as recited in Claim 14.

Block likewise fails to teach or suggest expedient embodiments that include (i) pre-suspending cellulose ether having free OH groups in 30 to 60% organic suspension medium; (ii) admixing the pre-suspended cellulose ether with an organic suspension medium and chemical compounds containing at least one aldehyde group and at least one acid group; (iii) filtering the admixed cellulose ether composition; (iv) drying the filtered cellulose ether composition; (v) comminuting the filtered cellulose ether composition; and (vi) heating the comminuted cellulose ether composition to react the acid groups and aldehyde groups of the chemical compounds with the OH groups of the cellulose ethers to form an ester bond or hemiacetal bond at a temperature ranging from 50 to 105 °C, as recited in Claim 15.

Accordingly, Applicants respectfully submit that the presently claimed method is patentable in light of Block, considered either alone or in combination with the remaining art of record.

Applicants respectfully submit that there would have been no motivation to have combined Menkart and Block. Menkart is directed to aldehyde treating agents. Block is directed to <u>drilling fluid compositions</u> including an aluminum agent. Applicants respectfully reiterate that these are extraordinarily different fields of endeavor and problems solved.

However, even if Applicants had combined Menkart and Block (which they did not), the claimed invention would not result.

The combination simply does not teach or suggest that methods for producing reversibly crosslinked cellulose ethers comprising first admixing, <u>but not dissolving</u>, cellulose ethers in water or an organic suspension medium along with chemical compounds containing at least one aldehyde group and at least one acid group <u>would result in reversibly crosslinked cellulose ethers providing lump-free stirrability</u>, as recited in the claimed invention. Menkart teaches that both dilute solutions and incredibly concentrated solutions are equivalent for forming his aldehyde-containing cellulose. Block merely teaches the crosslinking of dilute solutions.

As evidenced in the Declaration by Dr. Schultz submitted herewith, the use of compositions in which the cellulose ether is first admixed but not dissolved with an agent containing both an aldehyde group and an acid group unexpectedly resulted in reversibly crosslinked cellulose ethers providing lump-free stirrability. Such a result was surprising, to say the least.

Nor does the combination teach or suggest that chemical compounds containing at least one aldehyde group and at least one acid group are not released upon dissolving said reversibly crosslinked cellulose ether in a neutral or weakly acidic aqueous solution, as further recited in Claim 1. Block instead expressly teaches that compositions incorporating his crosslinked cellulose are alkaline.

And the combination most certainly does not teach or suggest such methods for producing lump-free reversibly-crosslinked cellulose ethers by admixing cellulose ethers selected from methylcellulose, ethylcellulose, methylhydroxyethylcellulose, methylhydroxypropyl-cellulose or ethylhydroxyethylcellulose with chemical compounds containing at least one acid group and at least one aldehyde group, as recited in Claim 1 as-amended. As noted above, it was altogether unexpected that the recited less reactive cellulose ether would react with the recited chemical compounds containing at least one acid group and at least one aldehyde group.

And the combination likewise does not teach or suggest that processes in which cellulose ether is pre-moistened with either 40 to 80 % water or 30 to 60% organic suspension medium would result in lump-free stirrability, as recited in Claim 11.

The combination similarly fails to teach or suggest particularly beneficial embodiments, in which the cellulose ether is pre-moistened with 40 to 80% water, the pre-moistened cellulose is admixed with water and chemical compounds containing at least one aldehyde group and at least one acid group, the admixed cellulose ether composition is comminuted; the comminuted cellulose ether composition is milled and the milled cellulose ether composition is then

crosslinked to form an ester or hemiacetal bond, as recited in Claim 14. As noted above, Menkart merely teaches mixing or tumbling, while Block teaches "contacting" or "reacting."

The combination also fails to teach or suggest expedient embodiments that include (i) pre-suspending cellulose ether having free OH groups in 30 to 60% organic suspension medium; (ii) admixing the pre-suspended cellulose ether with an organic suspension medium and chemical compounds containing at least one aldehyde group and at least one acid group; (iii) filtering the admixed cellulose ether composition; (iv) drying the filtered cellulose ether composition; (v) comminuting the filtered cellulose ether composition; and (vi) heating the comminuted cellulose ether composition to react the acid groups and aldehyde groups of the chemical compounds with the OH groups of the cellulose ethers to form an ester bond or hemiacetal bond at a temperature ranging from 50 to 105 °C, as recited in Claim 15.

Accordingly, Applicants respectfully submit that the claimed invention is patentable in light Menkart and Block, considered either alone or in combination.

CONCLUSION

It is respectfully submitted that Applicants have made a significant and important contribution to the art, which is neither disclosed nor suggested in the art. It is believed that all of pending Claims 1, 4, 7 through 9 and 11, 14 and 15 are now in condition for immediate allowance. It is requested that the Examiner telephone the undersigned if any questions remain to expedite examination of this application.

It is not believed that extensions of time or fees are required, beyond those which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time and/or fees are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required is hereby authorized to be charged to Deposit Account No. 50-2193.

Respectfully submitted,

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Claire Wygand

Claire Wygand

EXHIBIT I

Declaration by Dr. Andreas Schultz in conformance with 35 USC § 132